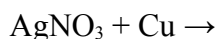


## Single Displacement Reactions

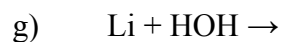
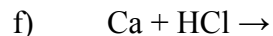
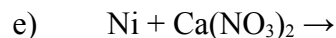
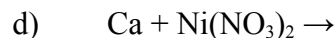
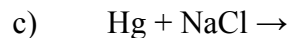
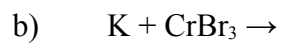
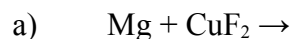
**Single Displacement Reactions** happen when one element *replaces* another in a compound. These types of reactions are easily identifiable based on their skeleton and balanced equations:




Metals higher on the list (at right) are more reactive. Thus, higher on the list = able to replace elements lower than themselves on the list in compounds.

You will be asked to predict what the products of particular reactions are. If no reaction will occur, we write “NR”.

Predict the products of these reactions (do not balance):



Metal	
lithium	
potassium	
barium	
calcium	
sodium	
magnesium	
aluminum	
zinc	
chromium	
iron	
cadmium	
cobalt	
nickel	
tin	
lead	
hydrogen	
copper	
mercury	
silver	
platinum	
gold	Least Reactive

## Double Displacement Reactions

**Double Displacement Reactions** occur when the anions and cations in two binary compounds switch partners.

### New Notation

The subscript on compounds and elements indicates the *state* of those substances.

$\text{CO}_{2(s)}$  means *solid*  $\text{CO}_2$  (dry ice)

$\text{CO}_{2(s)}$  means *gaseous*  $\text{CO}_2$

$\text{CO}_{2(aq)}$  means *aqueous*  $\text{CO}_2$  (dissolved in water)

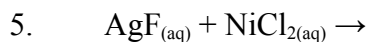
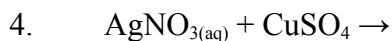
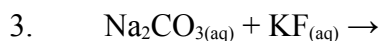
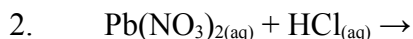
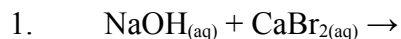
$\text{CO}_{2(l)}$  means *liquid*  $\text{CO}_2$

Most double displacement reactions involve aqueous salts that are mixed. But really, a reaction has only occurred if something changes state. For example:

Possible chemical reaction	Has a reaction occurred?
$\text{NaCl}_{(aq)} + \text{KF}_{(aq)} \rightarrow \text{NaF}_{(aq)} + \text{KCl}_{(aq)}$	
$\text{PbI}_{2(aq)} + \text{KCl}_{(aq)} \rightarrow \text{PbCl}_{2(s)} + \text{KI}_{(aq)}$	
$\text{CaCl}_{2(aq)} + \text{Zn}(\text{NO}_3)_{2(aq)} \rightarrow \text{Ca}(\text{NO}_3)_{2(aq)} + \text{ZnCl}_{2(aq)}$	
$\text{HCl}_{(aq)} + \text{NaOH}_{(aq)} \rightarrow \text{NaCl}_{(aq)} + \text{H}_2\text{O}_{(l)}$	

If nothing changes state, then it's just a mixture of a bunch of ions in water ... no chemical bonds have been broken or made.

Predict the products of the following reactions:



**Table 17.3** Solubilities of Ionic Compounds\* aq = aqueous (dissolves in water); s = solid (does not dissolve in water)

Ions	Acetate	Bromide	Carbonate	Chlorate	Chloride	Fluoride	Hydrogen Carbonate	Hydroxide	Iodide	Nitrate	Nitrite	Phosphate	Sulfate	Sulfide	Sulfite
Aluminum	s	aq		aq	aq	s		s	—	aq		s	aq	—	
Ammonium	aq	aq	aq	aq	aq	aq	aq	—	aq	aq	aq	aq	aq	aq	aq
Barium	aq	aq	s	aq	aq	s		aq	aq	aq	aq	s	s	—	s
Calcium	aq	aq	s	aq	aq	s		s	aq	aq	aq	s	s	—	s
Cobalt(II)	aq	aq	s	aq	aq	—		s	aq	aq		s	aq	s	s
Copper(II)	aq	aq	s	aq	aq	aq		s		aq		s	aq	s	
Iron(II)	aq	aq	s		aq	s		s	aq	aq		s	aq	s	s
Iron(III)	—	aq			aq	s		s	aq	aq		s	aq	—	
Lead(II)	aq	s	s	aq	s	s		s	s	aq	aq	s	s	s	s
Lithium	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	s	aq	aq	aq
Magnesium	aq	aq	s	aq	aq	s		s	aq	aq	aq	s	aq	—	aq
Nickel	aq	aq	s	aq	aq	aq		s	aq	aq		s	aq	s	s
Potassium	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq
Silver	s	s	s	aq	s	aq		—	s	aq	s	s	s	s	s
Sodium	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq
Zinc	aq	aq	s	aq	aq	aq		s	aq	aq		s	aq	s	s